REMARKS

In this Amendment, claims 1-9 have been canceled, leaving only claims 10-16 pending.

Interview Summary

Applicant thanks Examiner Kim for the telephonic interview on 28 February 2006 with inventor Michael Carney and the undersigned attorney. The Examiner's Interview Summary mailed 2 March 2006 accurately describes the interview. In the interview, Applicant stressed the importance of the precision required of the power transfer assembly described and claimed in the present patent application. Although no agreement was reached as to the patentability of the claims, the Examiner expressed his opinion that the invention is really in the incorporation of the power transfer assembly in a microturbine engine.

Claimed Invention

The invention recited in claim 10 includes a microturbine engine having a nickel alloy turbine wheel and a low-carbon carburized gear shaft having a pinion gear integrally formed therein, both of which are welded to a transition portion. The turbine wheel rotates in response to a flow of hot gas to rotate the pinion gear. The pinion gear in turn rotates a bull gear at a speed lower than the speed of rotation of the turbine wheel and pinion gear. The bull gear in turn drives a generator to generate electricity. Claims 11-16 recite further details of the invention, including among other things the materials, welding specifications, standards, and speed of the power transfer assembly.

Microturbine engines raise special engineering problems because of their size and speed. As components become smaller, tolerances often become tighter. Conventional techniques, for

example, of mounting a pinion gear on a shaft become unworkable in a microturbine engine environment. With a smaller shaft and smaller pinion gear, it becomes very challenging to form a structurally sound gear having a large number of teeth on a relatively small surface. Joining methods also become difficult because of the susceptibility of smaller parts to warp or break under thermal and mechanical loads. Thus, Applicant discovered that conventional tecniques for mounting a pinion gear on a shaft (e.g., by pressing) resulted in unacceptable distortion in the shaft or damage to the gear teeth. While other applications may accept some distortion and misalignment of parts, microturbine engines require a relatively high level of precision.

Microturbine engines operate at relatively high speeds, and thus require a means for reducing the rotational frequency of the engine output shaft to a frequency useful by a generator. One method for reducing the frequency (the one used in the Examiner's primary reference, as will be discussed below) is the use of power electronics. In that method, the output shaft is permitted to create electricity at high frequencies, and the generator then relies on electronic means (rectifiers and inverters) to bring the frequency down to a useful frequency. Another method for reducing the frequency (the one used in the present invention) is to use gearing to reduce the speed of the output shaft to the frequency of the power generator.

One advantage of using power electronics is that there is no need for a gear box and the precise gearing required to reduce the speed of the output shaft to the frequency of the generator. Also, the power electronics can handle varying frequencies (i.e., varying output shaft speeds) of the engine. One advantage of using mechanical gearing is that it avoids the need for complicated and expensive power electronics. These systems, however, require control systems that ensure that the output shaft runs at a substantially constant speed. It should therefore be appreciated that

the use of power electronics to condition the output frequency of a microturbine engine is a completely different solution to using gearing to mechanically reduce the speed.

Response to Claim Rejections

Because claims 1-9 have been canceled, the rejection of those claims has been rendered moot, and Applicant will address only the rejection of claims 10-16. The Examiner rejected claims 10-16 under 35 USC 103(a) as being unpatentable over Meister et al (6,363,706) in view of Araki (3,440,038) and either Staubli et al (2002/0136659) or Holko (4,333,670) and optionally in view of Wood et al (3,188,479).

Meister et al. teach a basic microturbine system, but are primarily concerned with a two-stage, intercooled compressor system to boost turbine power. Meister et al. teach a microturbine in which the power turbine 27 is coupled to the rotating portion of a generator 29 through a shaft 47 (col. 6, lns. 41-43). Meister et al. teach conditioning the frequency and quality of power output by the generator with power electronics, and specifically states that turbine speed can be reduced without affecting the frequency of the AC power output (col. 6, ln. 59 – col. 7, ln. 3). The Examiner points out that Meister et al. suggest driving a power train, but there is no teaching by Meister et al. of how that would be accomplished or for what purpose.

As discussed above, the present invention relates to a microturbine engine in which a gear reduction is used to drive the generator at a frequency that is directly useful by a generator. This is fundamentally different from what Meister et al. teach. One of ordinary skill in the art would not be motivated to provide any gearing between Meister et al.'s microturbine engine and the generator because Meister et al. teach using power electronics to handle the frequency reduction. Applicant therefore respectfully submits that the Examiner's primary reference

teaches away from the invention recited in claims 10-16, and that the modifications to this primary reference proposed by the Examiner are not realistic in the art.

Araki does not disclose how one might go about permanently joining a nickel alloy power turbine wheel to a low-carbon carburized gear shaft having an integrally-formed pinion gear. Araki is primarily concerned with the material properties of a nickel-based alloy. Although Araki teaches that the alloy can be used to construct a turbine rotor as pointed out by the Examiner, there is no teaching or suggesting in Araki that such turbine rotor would be suitable for a microturbine application, or that the welding technique Araki proposes would result in an assembly that would meet the tolerances and specifications required of a pinion gear shaft in a microturbine application.

The Examiner suggests the further combination of Staubli et al. or Holko with the above-discussed Meister et al. and Araki references. Staubli et al. and Holko are cited to show that transition regions can be used in welding processes. Neither of these references teaches joining a nickel alloy turbine wheel to a low-carbon carburized gear shaft having an integral pinion through the use of a transition portion. Further, Staubli et al. or Holko do not indicate that if the recited assembly were welded together using their techniques, that such assembly would be useful at microturbine engine speeds and tolerances. The Examiner has not provided any reason why one of ordinary skill in the microturbine arts would look to these references for guidance on welding techniques, or that there would a reasonable expectation of success using such techniques for the recited power transfer assembly of a microturbine engine.

The Examiner cites Wood et al. for teaching speed-reducing techniques. The only turbine/pinion combination taught by Wood et al. is the air turbine 10, shaft 13, and pinion 31. This combination of parts is used to start the engine. More specifically, stored compressed air

flows through the turbine 10, turns the shaft and pinion 31, which meshes with and turns a gear 32 to rotate the main shaft 36. Once the engine is up and running, an overrunning clutch 35 uncouples the shaft 36 from the gear 32. The Examiner has not provided any reason why one of ordinary skill in the microturbine arts would look to Wood et al. for guidance on speed reducing tecniques, or that there would a reasonable expectation of success using such techniques for the recited power transfer assembly of a microturbine engine.

Conclusion

The fundamental problem with the Examiner's rejection of claims 10-16 is that Meister et al. do not teach the use of a pinion gear/bull gear for providing an appropriate operating frequency of the generator. Meister et al. arguably teach away from the recited invention because Meister et al. teach the use of power electronics. Araki, Staubli et al., Holko, and Wood et al. do not overcome the problem, and even if they did, do not appear to teach mechanisms or methods that would give one of ordinary skill in the microturbine arts a reasonable expectation of success in achieving the claimed invention. Further, Applicant suggests that there would be no motivation to combine these secondary references with the teaching of Meister et al. because of the special considerations one has when designing a microturbine engine.

In view of the foregoing, Applicant respectfully requests that the Examiner allow claims 10-16.

Respectfully submitted,

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